Minimum Energy Routing in MANET

Jingran Gu
Professor Movaghar
NetSys 230
• Define the problem
• Understand the problem
• Available solutions
• Insight of the solutions
• Conclusion
MANET Scenario

- **Constraints**
  - Decentralized routing table
  - Runs on finite power
  - High Mobility

- **Goals**
  - Maximize longevity of the network
  - Fast routing
The problem

- Fundamental problem resort to minimum-energy broadcasting
- The nature of the problem is NP-complete
- Proved by converting a directed graph of MANET topology to a known NP-complete problem set cover
Nature of the problem

- NP-Complete
- Trade-off to solve in P
  - Solve specific Case optimal
  - Solve general case non-optimal
- Heuristic solutions
Sol. I – Locality Based

- Addressing the knowledge of underlying physical structure of nodes to produce results.
  - The Power-aware Localized Routing (PLR)
    - Assumes a source node has the location information of its neighbors and the destination.
    - Equivalent to knowing the link costs from the source node to its neighbors, all the way to the destination.
    - Not optimal based on the next hop selection.
  - Energy-Efficient Location Aided Routing (EELAR)
    - Limits area of discovery for each node
    - Conserves power and packet overhead
Sol. 2 – Longevity Based

- Protocol is conscious of total network lifetime and tries to maximize it.
  - Power-aware routing (PAR)
    - Selects less congested and more stable route
    - Use parameters: accumulated energy of a path, status of battery lifetime, and type of data
  - Geographical adaptive fidelity (GAF) protocol
    - Shuts down inactive routes.
Sol. 3 – Self Aware

- Protocol that took initiative to remove nodes from routing under certain conditions
  - The Prototype Embedded Network (PEN) protocol.
    - Power down idle devices
  - Power-aware Multiple Access (PAMAS) Protocol
    - PEN, discourage use of low powered nodes
Sol. 4 - Parasitic

- Algorithms optimizes power consumption that runs independent from network or can be easily integrated into existing algorithm
  - The Predictive Energy-efficient Multicast Algorithm (PEMA)
    - Uses statistical data from routing protocols to make routing decisions
  - Geographical adaptive fidelity (GAF) protocol
    - Independent of Underlying routing protocol
  - Local Energy-Aware Routing (LEAR)
    - Routing decision based on the local power.
Insight

• Due to the nature of NP-Complete many solutions exists.
  ◦ Some solves Minimum Energy Problem optimal (specific cases)
  ◦ Some solves the general case.

• Heuristic and Trade-offs are prominent factors in developing many of the algorithms.

• It is an art than science.
Alchemy in producing routing algorithms

- **Node** – Developing algorithm strictly on behalf of individual nodes rather than network as a whole.

- **Topology** – Always tries to obtains various global snapshots to support routing.

- **Decision** – Prediction and Threshold usage.

- **Total energy** – Explicitly consider total network energy in routing protocol.
Thank You